File UNL NUSF Economic Study

A Bureau of Business Research Report
From the UNL College of Business Administration

Final Report

Economic Impacts of Rural Telecommunications Firms

Prepared for Nebraska Rural Independent Companies

- Consolidated Telephone Companies
- Great Plains Communications
- Hartington Telecommunications Co.
- Hershey Cooperative Telephone Company
- K&M Telephone Company
- Nebraska Central Telephone Company
- Northeast Nebraska Telephone Companies
- Stanton Telephone Company
- Three River Telco

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February 15, 2013
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Executive Summary

Telecommunications infrastructure capable of providing advanced telecommunications and information services, such as broadband, as set forth in Nebraska Statutes[1] is an increasingly important asset for Nebraska communities, urban and rural alike. Nebraska is a diverse state with both rural and urban interests. While these interests can appear different, both populations rely upon each other to thrive within the State as well as nationally. Availability of these advanced services is critical for communities to successfully compete based on the strength of their labor force, the ingenuity of their businesses, and the value of their products and services.

This Report by the University of Nebraska-Lincoln Bureau of Business Research analyzes the role of universal service policies generally and specifically the role of the Nebraska Universal Service Fund (NUSF) relative to the competitiveness of Nebraska rural businesses and communities. The Report also examines the critical role that rural businesses play in the Nebraska economy.

In summary, the findings of this Report are that rural businesses not only support Nebraska's rural economy but also support thousands of jobs in Nebraska cities, including the two metropolitan areas of the State. The Report also finds that access to the types of services afforded by broadband infrastructure is an important factor influencing the growth of rural Nebraska businesses. Investment in more advanced networks for the provision of broadband services is positively correlated with business income, business location, education levels and the presence of young adults in rural Nebraska communities.

Specifically, the analysis contained in the Report demonstrates a strong correlation between median income in rural communities and the availability of higher speed broadband services and broadband subscribership. This correlation indicates that the presence and use of more advanced broadband services is associated with higher incomes in rural areas. Analysis also demonstrated a correlation between the availability of higher speed broadband services and the presence of industries in rural communities. Specifically, communities with higher speed broadband services were found to have businesses operating in more types of industries.

The availability of broadband services also appears to be associated with a higher educated and younger labor pool upon which rural business and communities can draw.

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[1] See Nebraska Revised Statutes at 86-323.

Analysis contained in the report indicates a positive correlation between higher available broadband speeds and the number of persons with college and graduate degrees residing in rural communities. Also, a similar positive correlation was observed between broadband speed and the number of individuals between the ages of 18 and 34 which live in rural communities.

Finally, the Report concludes that the Nebraska and Federal Universal Service Funds play a key role in the development of broadband infrastructure within small towns and the surrounding rural areas of Nebraska. Estimates indicate that the level of broadband infrastructure would decline by nearly 50% without support from these Universal Service Funds. This conclusion provides strong support for the State of Nebraska's continuing commitment to the NUSF in order to ensure universal access to advanced telecommunications and information services for rural Nebraska consumers and businesses.

The analyses contained in this Report provide strong evidence that the receipt of universal service dollars in the form of revenue support has a significant, positive impact on the broadband and related telecommunications investment by rural telecommunications providers in Nebraska. On average, historically every dollar of universal service support received by rural providers resulted in $4.60 of investment. In 2011, for the six rural companies included in the Report's analyses, the existing universal service funding mechanisms are estimated to have resulted in more $158 million of existing telecommunications infrastructure, more than 47% of the companies' total capital investment.

Further, universal service support also appears to play a role in offsetting expenses in economically unviable areas. Analyses indicate on average rural companies incur $0.16/year of expense to maintain and operate each dollar of investment in rural areas. The six rural companies are estimated to have incurred more than $25 million in expenses during 2011 to maintain and operate the telecommunications infrastructure investment which occurred as the direct result of universal service support. Given the relative low customer density in many rural areas, revenues received from customers are likely insufficient to recover these operating expenses. In these cases universal service support appears to be a necessity not only to make the investments but also to the operation and maintenance of such investments.

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I. Introduction

Telecommunications network infrastructure is an increasingly important economic asset for all Nebraskans. In the modern economy, viable communities must have cutting edge telecommunications and information services available at competitive prices. Such availability is critical for communities competing for both business and population. Perhaps more importantly, availability of advanced telecommunications and information services is critical to the success of businesses and the quality of life of all Nebraska residents.

Available infrastructure also has a practical implication of fostering a vibrant competition among our state's communities, requiring communities to compete based on the strength of their labor force, the ingenuity of their businesses, and the effectiveness of their services, rather than simply based on access to basic infrastructure and services. The alternative would be to create a permanent advantage in a handful of communities with a critical mass of citizens and business, a potentially much less competitive environment.

This Report by the UNL Bureau of Business Research examines the economic impact of advanced telecommunications and information services provided to rural communities in Nebraska, whether these communities consist of small towns or the surrounding rural areas. The Report examines benefits to both local and the State economies from providing rural areas with access to cutting edge telecommunications and information services supported by broadband infrastructure. The Report also examines how universal service programs help the private sector provide advanced telecommunications and information services including broadband access to consumers throughout Nebraska.

The Report will demonstrate that access to broadband infrastructure is and will be critical to the future of Nebraska's economy. While there has been a decline in demand for traditional landline voice services, this is not the result of customers abandoning so-called "plain old telephone service" at their businesses and residences, but rather is the result of customers substituting advanced services such as high-speed broadband services. In fact, the total number of Nebraska household connections to the fixed network has actually increased for companies despite the decline in traditional landline voice connections[2]. Further, fixed telecommunications services are typically designed for shared use. Fixed broadband service

[2] In 1998, the six companies included in the analyses contained herein had 45,126 connections to households. In 2011, the six companies had 47,536 connections.

such a digital subscriber line, allow users to connect routing devices so that multiple users can access different services simultaneously. Such shared use can be done either through wired connections attached directly to the routing device or wirelessly through a Wi-Fi connection. Potential alternatives such as cellular or mobile services are designed for a single user.

Moreover, as the mobile providers increasingly impose data limit caps, many users turn to Wi-Fi services provided by use of fixed telecommunications services provided over the wireline telecommunications network in order to meet their data usage needs at affordable costs. Nearly any wireless device sold today also has built in Wi-Fi for the purposes of allowing users to transfer usage which in the past had been carried only on the cellular networks to the wireline telecommunications network. It is this wireline telecommunications network which is supported by universal service policies. Additionally, some mobile devices such as Amazon's Kindle and Apple's IPAD are often sold with only Wi-Fi and not traditional cellular connectivity.

Our analyses are set forth in four sections that follow. Analyses in Section II describes the critical role that businesses located in rural Nebraska play in the State's economy, supporting business activity both in nearby trade centers and in the larger metropolitan areas of Omaha and Lincoln. The importance of access to advanced telecommunications and information services is examined in Section III, in particular how access to broadband contributes to the growth of rural businesses, and meets the needs of rural consumers. Analyses in Section IV describes the critical role that the Nebraska and Federal Universal Service Funds plays in creating an environment where private sector companies can invest in rural broadband infrastructure, the very types of investments that support growth in rural communities and employment in towns and cities throughout the State. Spending to support universal service provides key infrastructure and basic services to businesses and residential consumers located throughout the State. Other examples of this commitment to universal service are described in Section V, in particular state and federal efforts to support road systems, postal service, and health and education services in rural Nebraska. The conclusions reached in the Report are summarized in Section VI.

II. Importance of the Rural Economy to Urban Economies in Nebraska

The rural telecommunications network is a key component of the infrastructure of rural economies, along with road systems, electric services, education institutions and health services. Each of these key infrastructure components plays a central role in supporting rural

economies throughout the State of Nebraska, since each component is required by both modern businesses and the modern workforce. Inadequate or missing infrastructure hinders businesses of all kinds, meaningfully reducing the output of Nebraska's rural economy.

What is more, a lack of adequate telecommunications or other infrastructure would have a negative impact on the entire Nebraska economy, including urban Nebraska, since many urban businesses are reliant on the productive capacity of the rural Nebraska economy. Most notably, crops and livestock produced so abundantly in rural Nebraska have over time attracted a larger cluster of supplier and processor industries to the State. Many of these businesses are located in rural Nebraska, and are also dependent on the rural infrastructure system. However, many key processing businesses are also located in the urban areas of the State, including the metropolitan areas of Omaha and Lincoln and retail trade areas located throughout the State from Scottsbluff to Fremont.

This section considers these key linkages between the rural and urban economies within Nebraska. The first step is to describe Nebraska's large agricultural production complex, the key role of rural businesses within this complex, and the significant benefits of the complex to urban economies. In the second step, we examine the spillovers between rural businesses and suppliers located in rural Nebraska. This analysis focuses on key businesses of all kinds in rural Nebraska including manufacturing, agriculture, tourism, and other large businesses. Both steps demonstrate the central role that rural businesses play in the Nebraska urban economy and the Nebraska economy overall. The implication of this central role is that these key rural businesses must have access to adequate – if not robust - infrastructure and services to succeed, maximizing the benefits for both rural and urban economies within Nebraska.

A. The Agricultural Production Complex

Economic researchers have consistently found that rural economies play a critical role in the Nebraska economy (Thompson, Johnson and Giri, 2012).[3] This role is derived from the State's large output of crop and livestock production which underpins a large and growing agricultural production complex. That production complex is located throughout the State and includes a significant share of the State's manufacturing, transportation, and wholesale sectors. These impacts were reported in the document *The 2010 Economic Impact of the Nebraska Agricultural Production Complex* (Thompson, Johnson and Giri, 2012). The agricultural

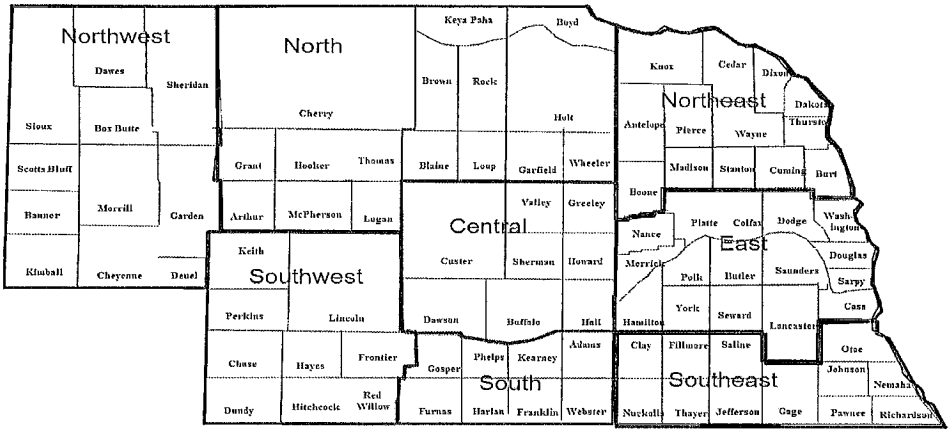
[3] Thompson, Eric, Bruce Johnson and Anil Giri, 2012. *The 2010 Economic Impact of the Nebraska Agricultural Production Complex,* Department of Economics, Report 192 (June)

production complex includes industries that supplies farmers and ranchers and process their production. Key supplier industries include industries such as farm implement manufacturers, implement dealers, agricultural cooperatives, and transportation services. Key processor industries include ethanol plants, mills, livestock slaughtering plants, and crop wholesalers, among others. Agricultural producers, key suppliers, and processors form a cohesive production complex because the suppliers and processors would not be located in Nebraska without the high levels of crop and livestock production in the state.

Specifically, the Report estimated the share of employment, labor income, value-added and output in Nebraska that is within the agricultural production complex. This complex includes both agricultural producers and the key processer or supply businesses that are present in the State due to Nebraska's enormous output of crops and livestock. A significant share of activity in the agricultural production complex is located in rural areas. In particular, the vast majority of agricultural production occurs in rural areas and a portion of the processing and supply industries is also located in rural areas. However, it is also true that a substantial share of the supplier and processor industry is located in more urban areas of Nebraska. This fact implies that a significant share of urban economies within Nebraska is dependent on a thriving rural business environment, and on the rural telecommunications and other infrastructure that supports the rural economy.

Table II.1 shows the share of direct labor income in Nebraska which results from employment within the agricultural production complex. The focus is on labor income in the complex itself, excluding any spillover (i.e., multiplier) impacts to other types of business. The share of labor income in the complex is shown separately for agricultural production such as crops and livestock and for other types of businesses such as manufacturers, wholesalers, or transportation firms. Results are provided both for the State overall and for eight agricultural regions within the State. The agricultural regions are listed in Figure II.1.

Figure II.1
The Agricultural Regions of Nebraska



Source: Reprinted from Thompson, Eric, Bruce Johnson, and Anil Giri, 2012. *The 2010 Economic Impact of the Nebraska Agricultural Production Complex*, Department of Economics, Report 192 (June)

Looking at the results in Table II.1, a large share of labor income in the complex occurs outside of production agriculture, in the types of key processor and supplier businesses that are often concentrated in the urban areas of the State. Such manufacturing, wholesale and transportation businesses are often located within trade centers such as Scottsbluff and Fremont, as well as in the Lincoln and Omaha metropolitan areas. Statewide, 6.5% of State labor income (including proprietor income) is earned in the agricultural production sectors of farming and ranching. However, an even a larger share of statewide labor income, 6.9%, is earned within other parts of the agricultural production complex in the areas of manufacturing, transportation and wholesale businesses.

Table II.1 Share of Labor Income in Agricultural Production Complex Businesses				
	Farming and Ranching		Other Complex Businesses	
Region	Amount (Millions $)	Share of Region	Amount (Millions $)	Share of Region
Northwest	$213.3	10.4%	88.7	4.3%
North	$181.1	31.7%	$50.0	8.7%
Northeast	$741.5	26.3%	551.0	19.5%
Central	$426.7	11.5%	628.3	17.0%
East	$836.3	2.2%	1,639.1	4.4%
Southwest	$303.1	18.7%	154.1	9.5%
South	$385.9	30.5%	179.2	14.1%
Southeast	$392.7	18.7%	400.6	19.1%
Total	$3,480.6	6.5%	3,691.0	6.9%

Source: Thompson, Eric, Bruce Johnson, and Anil Giri, 2012. *The 2010 Economic Impact of the Nebraska Agricultural Production Complex*, Department of Economics, Report 192 (June), Table 5.3

The pattern among individual regions demonstrates the concentration of these processing and supplier sectors in urban Nebraska. In the East region, which includes both Omaha and Lincoln, nearly two-thirds of labor income is earned in supplier and processing sectors, particularly in manufacturing businesses that either process agricultural goods or supply agricultural producers. The East is also the largest region in terms of labor income from farming and ranching. There is a large farm and ranching sector in the East region, and there are many manufacturing, transportation, and wholesaling businesses that are also located in rural areas in the East region. But, it is also clear that the agricultural production in rural Nebraska also supports a large manufacturing, transportation, and wholesaling industry in urban areas within the region, including the Omaha and Lincoln metropolitan areas and the Columbus and Fremont micropolitan areas.

The pattern is repeated in the Central region, which is home to the Grand Island, Kearney, and Lexington micropolitan areas. Labor income from farming and ranching is also slightly less than labor income in other complex businesses in the Southeast region, which is home to micropolitan areas such as Beatrice, and mid-sized towns such as Nebraska City and Fairbury.

To summarize, the data in Table II.1 shows that there is a large rural production complex related to agriculture which clearly supports manufacturing, transportation and wholesaling

businesses, many of which are located in urban Nebraska. Naturally, there are also many manufacturing, transportation, and wholesaling businesses located in rural Nebraska, including businesses that are not focused on agriculture. These businesses are discussed in the next section of the Report. In particular, these rural businesses also support businesses and employment in urban Nebraska in another way, through the multiplier effect, which is the additional employment and business activity that is created when businesses purchase goods and services and employees spend their paychecks. The next section examines how the activity of rural farming, ranching, manufacturing, transportation, tourism businesses and other major employers supports businesses and workers in urban Nebraska.

B. The Multiplier Impact of Rural Businesses on the Urban Economy

Beyond the direct employment and output discussed in the previous section, rural businesses also generate a significant multiplier impact on the urban Nebraska economy. These urban economies include regional trade centers such as Scottsbluff, North Platte, Lexington, Kearney, Hastings, Grand Island, Columbus, and Fremont as well as the two largest metropolitan areas of Omaha and Lincoln. This section will examine the impact of rural businesses, both agricultural and non-agricultural, on urban economies. A broad group of businesses were examined including farms, ranches, tourism businesses, manufacturers, and others. Specifically, we estimated how much employment exists in these urban economies in order to serve these rural businesses and their employees. In the analysis, note that farms, ranches, and other businesses located non-trade center counties and in NUSF supported areas of trade center counties (for example, rural Hall County) are considered to be rural businesses. Nebraska Rural Independent Companies were asked to provide lists of non-agricultural businesses for consideration in the economic impact analysis. The analysis does not consider business located in the Lincoln and Omaha metropolitan areas.

Such analysis is possible because of recent advancements in economic modeling software that allow researchers to estimate how direct economic activity (such as agricultural production) in one region impacts businesses in another region. Specifically, the research team will use this feature of the IMPLAN modeling system to assess how rural businesses impact the economies of Omaha, Lincoln and regional trade centers of Nebraska.

Analysis will focus on agricultural and non-agricultural businesses in areas supported by rural telecommunications companies. Analysis for each specific county will examine the economic impact of corn production, soybean production, other major crop production, and

livestock production on the same county, but also on the nearest retail trade area (i.e., micropolitan area), the City of Omaha and the City of Lincoln.

Economic impact analysis is comprised of two parts: 1) the direct economic impact and 2) the multiplier impact. The direct economic impact is sales, employment, and labor income of the agricultural producers, manufacturing firms, or tourism businesses located in a particular rural county. The multiplier effect is the additional economic activity at other businesses in Nebraska that either supply farmers, ranchers, manufacturers, or tourist businesses (wholesalers, accountants, energy providers, etc.) or are patronized by proprietors or employees of farmers, ranchers, manufacturers, and tourist businesses. Much of the multiplier impact occurs locally, in the same county. However, the multiplier impact can occur throughout the State at nearby retail trade centers, or in larger cities such as Lincoln and Omaha. In other words, the impact of rural agricultural and non-agricultural businesses on these cities occurs through the multiplier effect. Table II.2 lists the retail trade centers included in the analysis.

Table II.2
Trade Center Counties (Cities) Included in the Analysis

Gage	(Beatrice)
Platte	(Columbus)
Dodge	(Fremont)
Hall	(Grand Island)
Adams	(Hastings)
Scotts Bluff	(Scottsbluff)
Box Butte	(Alliance)
Madison	(Norfolk)
York	(York)
Buffalo	(Kearney)
Dawson	(Lexington)
Otoe	(Nebraska City)
Lincoln	(North Platte)
Dakota	(South Sioux City)

Table II.3 shows the direct economic impact of agricultural producers located in rural counties. The "other" category includes hog production as well as selected manufacturers and other key non-agricultural businesses located in service territories supported by the Nebraska Universal Service Fund (NUSF). Results are presented for the year 2010 since this is the most current year for which IMPLAN economic multipliers are available to conduct the analysis. 2010

is also a useful year for analysis since it reflects the recent growth in the value of Nebraska agricultural output but is not a "peak year" such as 2011 or a "drought year" such as 2012.

Table II.3 Direct Impact by Category 2010	
Category	Direct Impact (Millions $)
Crops	$8,299.7
Cattle Ranching	$7,910.4
Other	$1,790.6

Source: IMPLAN

As would be expected, the magnitude of the economic impacts is on the order of billions of dollars. This result is similar to what was found in the Report *The 2010 Economic Impact of the Nebraska Agricultural Production Complex*. The total economic impact exceeds this direct impact and includes the "multiplier" impact on businesses and workers throughout the State's economy. This multiplier impact occurs in a multitude of businesses that provide supplies and services for other business and/or provide goods and services to households. In addition to impacting a variety of industries, multiplier activity impacts a variety of geographies. As seen in Table II.4, a portion of the multiplier impact occurs within the same county but important portions also occur in nearby trade centers and in large cities, such as Omaha and Lincoln in the case of Nebraska.

Table II.4 Multiplier Impact By Geography					
		Multiplier Impact (Millions $)			
Category	Direct Impact (Millions $)	Same County	Nearest Trade Center Area	Lincoln MSA	Omaha MSA
Crops	$8,299.7	$2,383.2	$1,191.1	$92.3	$334.9
Cattle Ranching	$7,910.4	$4,421.1	$1,312.3	$67.2	$250.5
Other	$1,790.6	$380.7	$143.5	$21.4	$126.8

Source: BBR calculations using IMPLAN

Table II.5 show the multiplier impact according to another metric, value-added. The pattern of results is similar with the largest impact in nearby trade centers. Table II.6 shows the multiplier impact in terms of labor income and Table II.7 shows the impact in terms of employment. Rural businesses support thousands of jobs in the Omaha and Lincoln metropolitan areas.

Table II.5 Multiplier Impact By Geography - Value-Added					
		Multiplier Impact (Millions $)			
Category	Direct Impact (Millions $)	Same County	Nearest Trade Center Area	Lincoln MSA	Omaha MSA
Crops	$8,299.7	$1,264.4	$657.4	$93.6	$201.4
Cattle Ranching	$7,910.4	$1,284.3	$437.1	$34.9	$122.3
Other	$1,790.6	$239.9	$73.7	$11.2	$69.8

Source: BBR calculations using IMPLAN

Table II.6 Multiplier Impact By Geography - Labor Income					
		Multiplier Impact (Millions $)			
Category	Direct Impact (Millions $)	Same County	Nearest Trade Center Area	Lincoln MSA	Omaha MSA
Crops	$8,299.7	$567.2	$311.7	$36.5	$142.2
Cattle Ranching	$7,910.4	$520.7	$191.8	$23.4	$80.4
Other	$1,790.6	$113.7	$39.8	$7.2	$45.7

Source: BBR calculations using IMPLAN

Table II.7 Multiplier Impact By Geography – Employment					
		Multiplier Impact			
Category	Direct Impact (Millions $)	Same County	Nearest Trade Center Area	Lincoln MSA	Omaha MSA
Crops	$8,299.7	20,700	10,900	1,200	3,500
Cattle Ranching	$7,910.4	17,500	5,800	600	1,700
Other	$1,790.6	3,900	1,200	200	900

Source: BBR calculations using IMPLAN

III: The Importance of Telecommunications Services to Rural Businesses

Next, we endeavored to measure the impact, if any, that the availability and use of advanced telecommunications and information services in rural communities had on businesses in those areas. For our purposes, we focus on three specific areas: median income by business category, education level, and age. We obtained median income for communities

in Nebraska within the nine specific categories[4] shown below from the American Community Services (ACS) data.

- Construction
- Educational services
- Healthcare & Social Assistance
- Information
- Manufacturing
- Professional, Scientific, & Technical
- Retail Trade
- Transportation & Warehousing
- Wholesale Trade

Further, for rural businesses to be competitive in today's markets, they need access to well-educated and younger employees. As a measure of the educated individuals in rural communities, we obtained the number of persons that have attained at least a college degree and those that attained a graduate degree in these areas.[5] As a measure of the number of younger potential employees in rural communities, we obtained the number of individuals in each community that were between the ages of 18 and 34.[6]

Normally, we would have tested the ACS values we obtained for communities in Nebraska with broadband against those communities without broadband services. However, rural companies have deployed broadband services to nearly all communities with Nebraska and we needed to use a different specification. For this reason we developed and used two independent variables in our analysis. This first was the ratio of households subscribed to broadband services to total households to whom broadband services were available within a community. We also used available speed as a surrogate of the quality of the broadband service offered in a community. To this end, we obtained subscribership and available speed information for 159 rural Nebraska communities. These communities represent 63% of the estimated 253 communities which are served by rural telecommunications providers in Nebraska. The average number of households in these 159 communities is 155 and the largest is Imperial Nebraska with 893 households.

The correlation between the chosen dependent variables (median earnings, education, and age) and the independent variables (available speed and broadband subscribership) was

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[4] S2403, INDUSTRY BY SEX AND MEDIAN EARNINGS IN THE PAST 12 MONTHS (IN 2010 INFLATION-ADJUSTED DOLLARS) FOR THE CIVILIAN EMPLOYED POPULATION 16 YEARS AND OVER 2006-2010, American Community Survey 5-Year Estimates, downloaded from http://factfinder2.census.gov

[5] B15001, SEX BY AGE BY EDUCATIONAL ATTAINMENT FOR THE POPULATION 18 YEARS AND OVER Universe: Population 18 years and over, 2006-2010 American Community Survey 5-Year Estimates, downloaded from http://factfinder2.census.gov

[6] B01001, SEX BY AGE Universe: Total population, 2006-2010 American Community Survey Selected Population Tables, downloaded from http://factfinder2.census.gov

calculated using the formulas shown below. The correlation values were tested for significance at the 99th percentile and the results are shown in Tables III.1A and III.1B.

$$Corr(y,x) = \frac{Cov(y,x)}{\sqrt{Var(y)} * \sqrt{Var(x)}} \quad t-stat = Corr(y,x) * \sqrt{\frac{n-2}{1-Corr^2(y,x)}}$$

Table III.1A
Correlation of Dependent Variables with Available Speed

Category	Correlation	t-Stat	t-Crit	Result
Construction Earnings	0.2591	3.26	2.35	Positive, Significant
Manufacturing Earnings	0.3243	4.17	2.35	Positive, Significant
Wholesale Trade Earnings	0.2318	2.90	2.35	Positive, Significant
Retail Trade Earnings	0.2872	3.65	2.35	Positive, Significant
Transportation & Warehousing Earnings	0.2841	3.60	2.35	Positive, Significant
Information Earnings	0.1414	1.74	2.35	Positive, Not Significant
Professional, Scientific, & Technical Earnings	0.2008	2.49	2.35	Positive, Significant
Education Services Earnings	0.4072	5.42	2.35	Positive, Significant
Healthcare & Social Assistance Earnings	0.3519	4.57	2.35	Positive, Significant
College or Graduate Degree, 18 Years or Older	0.3804	5.00	2.35	Positive, Significant
Graduate Degree, 18 Years of Older	0.3490	4.53	2.35	Positive, Significant
Population, 18 to 34 Years Old	0.3453	4.48	2.35	Positive, Significant

Table III.1B
Correlation of Dependent Variables with Broadband Subscribership

Category	Correlation	t-Stat	t-Crit	Result
Construction Earnings	0.1081	1.32	2.35	Positive, Not Significant
Manufacturing Earnings	0.2281	2.85	2.35	Positive, Significant
Wholesale Trade Earnings	0.0505	0.62	2.35	Positive, Not Significant
Retail Trade Earnings	0.2521	3.17	2.35	Positive, Significant
Transportation & Warehousing Earnings	0.1421	1.75	2.35	Positive, Not Significant
Information Earnings	0.1031	1.26	2.35	Positive, Not Significant
Professional, Scientific, & Technical Earnings	0.0827	1.01	2.35	Positive, Not Significant
Education Services Earnings	0.2502	3.14	2.35	Positive, Significant
Healthcare & Social Assistance Earnings	0.2464	3.09	2.35	Positive, Significant
College or Graduate Degree, 18 Years or Older	0.0793	0.97	2.35	Positive, Not Significant
Graduate Degree, 18 Years of Older	0.1076	1.32	2.35	Positive, Not Significant
Population, 18 to 34 Years Old	0.0134	0.16	2.35	Positive, Not Significant

The correlations for both available broadband speed and broadband subscribership with median earnings, education, and age are positive. A positive correlation between two variables

signifies that on average as the values of one of the variables increases, the values of the other variables increases as well. However, not all of the relationships are statistically significant, meaning that the two variables are not strongly correlated in all categories. Except for median earnings for information services, available broadband speed and the variables for median earnings, education, and age are both positively correlated and significant at the 99th percentile. Only the positive correlations between broadband subscribership and the variables for manufacturing, retail trade, educational services, and healthcare & social assistance earnings are statistically significant at the 99th percentile. **This analysis indicates that the median earnings, higher educated population, and younger workforce are positively correlated with available broadband speed. This result is consistent with the premise that rural communities with higher available broadband speeds generally have higher median earnings and more highly educated and younger residents.**

The correlation between the two independent variables, available broadband speed and broadband subscribership was also tested. This indicated that available broadband speed and broadband subscribership are highly correlated, with the results positive and significant at the 99th percentile. Given this result, the relationship between these two variables was quantified using ordinary least square regression. Since available broadband speed appears to be the stronger explanatory variable, as shown later in the analyses contained in this Report, it was selected as the independent variable and the following model specification was employed.

$$Subscribership = \beta_1 + \beta_2 Speed$$

The coefficient on available broadband speed was significant at the 99.99th percentile and the results are shown in Table III.2 below.

Table III.2
Coefficient Estimate for $Subscribership = F(Speed)$

Speed Coefficient	T-Stat
0.065144	7.437351

These results indicate that, on average, a 1 mbps increase in available broadband speed increases broadband subscribership by 6.5%

Next, we sought to determine if broadband speed and subscribership are correlated with the likelihood of a business locating in a rural area. To this end, we used the median income by business category for the 159 rural Nebraska communities. For each of the nine business

categories, an indicator series was created. If the ACS data indicated that a community had income for a given business category, the relevant indicator series took on a value of one for that observation and zero otherwise. Then each indicator series was tested against broadband speed and broadband subscribership using a probit model specification. A probit model tests whether the independent variables increase or decrease the likelihood of a given event occurring. In our test, the event is businesses locating in rural communities based upon income for that business category. The model specification used for each of the nine business categories is shown below.

$$\begin{aligned} IND_{Business} &= \beta_1 + \beta_2 Speed + \beta_3 Subscribership \\ p &= P[Z \leq \beta_1 + \beta_2 Speed + \beta_3 Subscribership] \\ &= \Phi(\beta_1 + \beta_2 Speed + \beta_3 Subscribership) \end{aligned}$$

For each of the nine business categories, the probit model results indicated that available broadband speed was positively correlated with the likelihood of a rural community having income in the relevant business category. All nine of the speed coefficients were positive and significant at the 97th percentile and eight of the nine coefficients were significant at the 99th percentile. **This indicates that rural communities with higher available broadband speed also have a higher likelihood of businesses being located within the community.**

When modeled with available broadband speed, none of the variables associated with broadband subscribership were significant at the 80th percentile. When available broadband speed is excluded and the model specification $p = P[Z \leq \beta_1 + \beta_2 Subscribership]$ is used, all coefficients on broadband subscribership are positive. For seven of the nine business categories, the associated coefficients are significant at the 90th percentile, and four of the nine categories are significant at the 98th percentile. **These results are indicative of broadband subscribership having a positive relationship with the location of businesses in rural communities. However, available broadband speed appears to have a stronger relationship with business location than broadband subscribership**. Further, we cannot exclude the possibility that the positive correlation between subscribership and business location only results because broadband subscribership is correlated with broadband speed.

Next, the analysis sought to determine if an increased likelihood that rural communities had higher median income in the nine business categories was correlated with available broadband speed and broadband subscribership. The average median income across the 159

rural communities was calculated for each business category. Indicator series were created for each business category. If the median income for a community in a given business category was greater than the average for that category, the indicator series took on a value of one for that observation or zero otherwise. Then the model specification $p = P[Z \leq \beta_1 + \beta_2 Speed + \beta_3 Subscribership]$ was used for the indicator series associated with each business category.

The available broadband speed coefficients for each of the nine business categories were positive and significant at the 90th percentile and significant at the 98th percentile for eight of the nine categories. **These results are consistent with the premise that rural communities with higher available broadband speeds are more likely to have higher median income in each of the nine business categories.**

Similar to earlier results, when modeled with available broadband speed, only one of the coefficients on broadband subscribership was significant at the 90th percentile. However, when the functional form of $p = P[Z \leq \beta_1 + \beta_2 Subscribership]$ is again used, all the coefficients on broadband subscribership are positive. Eight of the nine coefficients are significant at the 84th percentile and five of the nine are significant at the 98th percentile. **These results are indicative of broadband subscribership being correlated with higher median income. However, again these results suggest available broadband speed has a stronger influence on median income that broadband subscribership.** Further, we cannot exclude the possibility that the positive correlation between subscribership and business income only results because broadband subscribership is correlated with broadband speed.

Next, a similar analysis was performed on education and age. The average number of individuals holding at least a college degree, individuals holding graduate degrees, and individuals between the ages of 18 and 34 were calculated across the 159 rural communities in this analysis. Three indicator series were created. If the number of individuals in a given community exceeded the relevant average, the indicator series took on a value of one for that observation or zero otherwise. The probit model specification $p = P[Z \leq \beta_1 + \beta_2 Speed + \beta_3 Subscribership]$ was then used to measure the likelihood of above average educated and younger individuals in rural communities based on available broadband speed and broadband subscribership.

The coefficients on available broadband speed were positive and significant at the 85th percentile for individuals holding at least a college degree, those holding a graduate degree, and those between the ages of 18 and 34. Two of the three coefficients were significant at the

90th percentile. **These results demonstrate that higher available broadband speeds are correlated with a higher educated and younger population within rural communities.**

The coefficients on broadband subscribership were not statistically significant for either individuals holding at least a college degree, those holding a graduate degree, or those between the ages of 18 and 34. This finding was observed both when broadband subscribership was modeled jointly with available broadband speed and when modeled separately. **Thus these findings suggest that broadband subscribership does not increase the probability of having a higher educated and younger population within rural communities.**

In summary, available broadband speed and broadband subscribership are positively correlated with both median earnings and higher educated and younger populations in rural communities in Nebraska. Further available broadband speed appears to increase the probability of a rural community having higher than average median earnings as well as a higher education and younger population. Finally, higher available broadband speeds appear to be associated with increased broadband subscribership within rural communities.

IV: The Role of the Universal Service Fund in Deployment of Broadband Infrastructure

The concept of universally available telecommunications service has existed for many decades. It was formally adopted as the policy of United States with the passage of the Telecommunications Act of 1934. At its heart, the policy and implementation of universal service is relatively straight-forward. In exchange for charging a rate below the cost of providing a given service, a telecommunications provider receives revenue through another means to recoup any unrecovered costs related to the service(s). These "universal service" revenues can be generated through either implicit (combined in the rate for another service) or explicit (a stand-alone rate(s)) means.

With the break-up of the Bell system in 1984, the primary source of universal service shifted from "settlements and separations" to a system of "access charges" assessed by local telephone companies on the providers of long distance telecommunications services. These access revenues were then used to support the higher cost of providing local telephone service in rural areas. Other secondary sources of universal service support included charging higher rates for business local exchange services than residential local exchange service and charging the same residential local service rates to customers located in low-cost and high-cost markets.

However, some parties argued that implicit support provided by access charges were inefficient, discriminatory and anti-competitive. As part of the Telecommunications Act of 1996, Congress required that implicit universal service support should become explicit. In response to the passage of the Telecommunications Act of 1996, the Federal Communications Commission (FCC) reduced the implicit support provided by access charges and other means and began recovering the costs associated with universal service obligations through explicit universal service surcharges assessed on consumer billings.

In 1997, the Nebraska Legislature enacted the Nebraska Telecommunications Universal Service Fund Act "which supplements federal universal service support mechanisms." *Neb. Rev. Stat.* § 86-317. Administration of this Act was delegated to the Nebraska Public Service Commission (NPSC). Similar to the FCC's actions regarding implicit subsidies, the NPSC implemented rate restructuring by reducing intrastate access charges, increasing local exchange rates and implementing an NUSF surcharge. The NUSF High Cost Program distributes support to high cost areas of the State to promote universal service where no business case exists for a private, for profit telecommunications carrier to provide service.

In determining the amount of universal service support to be provided to a local exchange service provider, the NPSC takes into account the total cost of providing telecommunications service, the total revenues received by a provider from its customers and the amount of federal universal service support the provider receives. Such information is collected annually by the NPSC and used in determining universal service support to be received by qualifying companies. In addition to revenues information, the NPSC collects information on the costs incurred in the provision of telecommunication services. These costs include the total dollar amount of investment which a carrier has made in telecommunications infrastructure as well as total operating expenses.

The most significant cost in the provision of broadband and other telecommunications services in rural areas is what is referred to as the local loop. The local loop is the physical link that connects a customer's location to the telecommunications provider's network. In the development of its current funding methodology, the NPSC used only loop cost in its cost calculations. In order to establish costs of local loops across the State, the NPSC conducted a lengthy docket in which it collected data on loop costs for 1,240 geographic areas within the State[7]. The average loop cost was 10 times higher for those areas with costs above the median

[7] In the Matter of the Nebraska Public Service Commission, on its own motion, seeking to establish a long-term universal service funding mechanism, NUSF-26, Findings and Conclusions, entered November 3, 2004.

than those below. For the top 10% highest cost areas, the average cost was nearly 50 times higher than those in the bottom 10%. This resulted in a conclusion was that there is a vast disparity in loop costs between geographical areas of the State and investments in such facilities represent a primary factor in the need for universal service. Population density was found to be the driver of loop costs. The highest cost areas are out of town locations and distribution of NUSF support is based upon density driven costs.

Loop facilities represent a significant amount of the total investment made by rural telecommunications providers. The lower the customer density and the longer the distance of the local loop that consists of copper wire or fiber optic cable, the greater is the cost to provide service. Further, in order to provide broadband services in rural areas, significant upgrades need to be made so that local loop facilities can carry the increased bandwidth required to provide these and other advanced services. Thus the ability of rural providers to undertake such investments in loop plant infrastructure is vital to the provision of broadband services. As such, we endeavored to identify if universal service funding has any impact on the level of infrastructure that a rural carrier can sustain. Given that universal service funding has existed in many forms, in both implicit and explicit forms, we examined the relationship between total investment, referred to a total plant in service, and total revenues.

We obtained the NUSF data submitted by six rural providers in Nebraska. For two providers we obtained data for the years of 1998 through 2011. From three providers we obtained data for the years of 1999 through 2011. From one provider we obtained data for the years of 2002 through 2011.

We tested the hypothesis that total plant in service ($TPIS_t$) was a function of total revenues lagged one period (REV_{t-1}) and total revenues lagged two periods (REV_{t-2}) as shown below.

$$TPIS_t = \beta_1 REV_{t-1} + \beta_2 REV_{t-2}$$

In the event that a change in ownership or regulatory accounting practices occurred for a company during the time frame of our analysis, indicator variables (IND_{Event}) were employed to determine if the event(s) had a statistically significant change on the underlying trend.

$$TPIS_t = \beta_1 REV_{t-1} + \beta_2 REV_{t-2} + \beta_3 IND_{Event}$$

Further, in the case where there was some level of common ownership between two companies, we also tested whether the revenues of the affiliated company influenced the investment level of a company. The following specifications were tested:

$$TPIS_t = \beta_1 REV_{A,t-1} + \beta_2 REV_{A,t-2} + \beta_3 REV_{B,t-1} + \beta_4 REV_{B,t-2}$$
$$TPIS_t = \beta_1 REV_{A,t-1} + \beta_2 REV_{A,t-2} + \beta_3 REV_{B,t-1} + \beta_4 REV_{B,t-2} + \beta_5 IND_{Event}$$
$$TPIS_t = \beta_1 (REV_{A,t-1} + REV_{B,t-1}) + \beta_2 (REV_{A,t-2} + REV_{B,t-2})$$
$$TPIS_t = \beta_1 (REV_{A,t-1} + REV_{B,t-1}) + \beta_2 (REV_{A,t-2} + REV_{B,t-2}) + \beta_3 IND_{Event}$$

The total plant in service of only one company appeared to be influenced by total revenues lagged two periods (REV_{t-2}). However, for all six companies, revenues lagged one period (REV_{t-1}) exhibited a high level of significance related to total plant in service. The Durbin-Watson test was employed to identify if auto-correlation among the error terms existed. In the event the Durbin-Watson test indicated the possible presence of autocorrelation, the standard errors were adjusted accordingly. Further, the autocorrelation and partial autocorrelation functions of the residuals were reviewed. In the event that an autoregressive (AR) or moving average (MA) model was indicated, the model specification was adjusted accordingly.

The models were tested for misspecification[8] and multi-collinearity[9]. None of the model described above exhibited signs of either misspecification or multi-collinearity. Following is a table of the results obtained from the models specified above.

Table IV.1
Coefficient Estimates for $TPIS = F(Rev)$

Company	Revenue Coefficient	T-Stat	Regression R Squared
A	4.10944	8.00531	0.95654
B	3.17125	72.71360	0.87965
C	3.35992	862.06000	0.84864
D	5.39949	33.02540	0.84457
E	5.50377	7.74817	0.89531
F	4.68418	34.06350	0.85547

[8] The Ramsey RESET test with 3 fitted terms $(\hat{Y}^2, \hat{Y}^3, \& \hat{Y}^4)$ was used to identify possible mis-specification in the models.

[9] Multi-collinearity was tested by review of the auxiliary R-squared results and the covariance of the coefficients.

All of the coefficients on the revenues variables are significant at greater than the 99.9th percentile. The coefficients range from 3.17 to 5.50 with a weighted average of 4.60. This means that for each dollar of revenue, rural companies, on average, make an investment in telecommunications infrastructure of $4.60.

Next, these revenue coefficients were used to estimate the amount of investments which exists as a result of the receipt of universal service support, both federal and State. ***Based on universal service receipts in 2011, more than $158 million or 47.08% of the total investments made by these six companies can be attributed to the universal service revenue support they received. In other words, the receipt of universal service support has allowed rural companies to nearly double the amount of telecommunications infrastructure in their rural service areas.***

We lack the information to specifically identify those communities that only have telecommunications service as a result of universal service support. However, our analysis suggests that the number of communities that only have service as a result of universal service is not inconsequential.

These results are based on a critical assumption. Traditionally federal and state universal service fund programs have required funding recipients to use private equity as the source for financing investment in high cost and other areas. Then, to the extent a given company is not able to recover the costs of investing and the expenses of providing telecommunications services in these high cost areas directly from its customers, universal service funds provide supplemental revenue support. Under this regime, universal service support is treated as revenue to the recipient companies rather than direct investment by agencies of government into private companies. As a result of this policy, universal service funds are leveraged at nearly a 5 to 1 ratio as evidenced by the weighted revenue coefficient of $4.60 discussed earlier. If universal service funds are no longer provided or a portion of these funds are converted into a grant program, this leveraging of universal service dollars would no longer occur.

Next, we sought to determine if the receipt of universal service support was also needed to cover operating expenses associated with the provision of service in high cost areas. To this end, we examined the relationship between operating expenses and total investment. Given that our analysis provides evidence that a significant amount of total investment is the result universal service support, we endeavored to quantify the amount, if any, of operating expenses that could be attributed to universal service supported investments. Similar to our regression

analysis of $Total\ Investment = F(Total\ Revenue)$, this analysis similarly used NUSF information provided to the NPSC to test the hypothesis that $Total\ Expenses = F(Total\ Investment)$. The model specification used is shown below.

$$TotExp_t = \beta_1 TPIS_t$$

In a manner similar to our total investment analysis, if a change in ownership or regulatory accounting practices occurred for a company during the time frame of our analysis, indicator variables (IND_{Event}) were employed to determine if the event(s) had a statistically significant change on the underlying trend.

$$TotExp_t = \beta_1 TPIS_t + \beta_2 IND_{Event}$$

Further, in the case where there was some level of common ownership between two companies, we also tested whether the revenues of the affiliated company influenced the investment level of a company. The following specifications were tested:

$$\begin{aligned} TotExp_t &= \beta_1 TPIS_{A,t} + \beta_2 TPIS_{B,t} \\ TotExp_t &= \beta_1 TPIS_{A,t} + \beta_2 TPIS_{B,t} + \beta_3 IND_{Event} \\ TotExp_t &= \beta_1 (TPIS_{A,t} + TPIS_{B,t}) \\ TotExp_t &= \beta_1 (TPIS_{A,t} + TPIS_{B,t}) + \beta_2 IND_{Event} \end{aligned}$$

Total operating expenses for all six companies appears to be highly influenced by the current level of total investment, as the coefficients exhibited a high level of significance. The Durbin-Watson test was employed to identify if auto-correlated errors existed. The regression results for three of the companies showed possible indications of auto-correlation and the standard errors were adjusted accordingly. The results for one company indicated possible heteroskedasticity and appropriate adjustments were made. Further, the autocorrelation and partial autocorrelation functions of the residuals were reviewed. In the event that an autoregressive (AR) or moving average (MA) model was indicated, the model specification was adjusted accordingly.

The models were tested for misspecification[10] and multi-collinearity[11]. None of the models described above exhibited signs of either misspecification or multi-collinearity. Following is a table of the results obtained from the models specified above.

[10] The Ramsey RESET test with 3 fitted terms $(\hat{Y}^2, \hat{Y}^3, \& \hat{Y}^4)$ was used to identify possible mis-specification in the models.

Table IV.2 Coefficient Estimates for $Exp = F(TPIS)$			
Company	Investment Coefficient	T-Stat	Regression R Squared
A	0.19559	92.95047	0.95946
B	0.18076	88.40864	0.90024
C	0.06786	33.92465	0.73285
D	0.14817	57.18092	0.84657
E	0.11622	242.99782	0.98891
F	0.19480	5.77220	0.97919

All of the coefficients on the total investment variables are significant at the 99.9th percentile. The coefficients range from 0.07 to 0.20 with a weighted average of 0.16. This means that for each dollar of investments, companies, on average, incur $0.16 of operating expenses. ***The receipt of universal service support enables the six companies in our study to make $158 million of investment in high cost areas which they likely would not be able to make otherwise. These high cost investments are estimated to cause the companies to incur additional operating costs of $26 million. As such universal service support is necessary not only for investment in high cost areas but operating expenses as well.***

V: The Universal Service Fund in the Context of Rural Development Efforts

Support for rural telecommunications services through the universal service funds falls within a broader tradition to promote rural growth in Nebraska and ensure that rural areas have the infrastructure and services needed to remain competitive with urban areas. The tradition is best seen in the level of support in rural Nebraska for other key utilities services, the postal service, and highway systems. Rural telecommunications services also improve the delivery of the key services of health care and education to rural Nebraska. State government has also traditionally had a role in delivering these services to Nebraska households. Support for broadband infrastructure is an effective way to do so. Each of these issues is discussed in more detail in the paragraphs that follow, beginning with a discussion of road infrastructure.

[11] Multi-collinearity was tested by review of the auxiliary R-squared results and the covariance of the coefficients.

A. Nebraska's Tradition of Support for Rural Infrastructure and Key Services

Roads provide critical infrastructure for business and community development throughout Nebraska. Given the importance of roadways, it is perhaps not surprising that the State of Nebraska has been active in providing adequate highway service to communities throughout the State, and support for local road systems within cities and counties. These efforts might even be described as a program to provide universal roadway transportation services throughout the State of Nebraska. The completed and proposed Nebraska Expressway System is an excellent example. The goal of the expressway system is to provide all communities of population 15,000 and higher with access to the interstate highway system. Further, by affording this access, the system also provides vastly improved access to small communities or rural countryside located along or adjacent to the expressway system. .

Development of the expressway system in Nebraska over the last two decades has represented a substantial expenditure to improve the highway services to rural areas, small towns, micropolitan areas and other larger towns (of at least 15,000 population) across the State. The State of Nebraska has taken steps to accelerate the completion of the expressway system in recent years by developing a new funding source for investment projects. Specifically, the Legislature recently passed legislation (LB 84) in order to expand highway spending in Nebraska with a State Highway Capital Improvement Fund supported with 0.25 cents of Nebraska's 5.5 cent per dollar State sales tax. Twenty-five percent of the funding was specifically designated for spending on the Nebraska Expressway system or federally designated High Priority Corridors, which include the Heartland Expressway in the western panhandle of Nebraska. The remainder will be allocated according to Nebraska Department of Road priorities.

Another effort to provide universal road transportation services to towns and counties throughout rural Nebraska is evident in the Nebraska Highway Fund Allocation. This allocation provides funds to local governments to support maintenance and construction of local roads. The allocation approach implicitly provides extra funding to help rural areas maintain a similar level of service despite higher costs per person served. Specifically, the State Highway Fund Allocation is weighted according to three factors: 1) population, 2) number of vehicle registrations and 3) number of lane miles. The latter factor tends to steer allocation dollars to less densely settled areas given the need for more lane miles per person.

Recent debate about the solvency of the U.S. Postal Service provides another example of the commitment in Nebraska to universal service for smaller rural communities. As part of

planned cost reductions, the U.S. Postal Service was considering closure of thousands of primarily rural post offices throughout the United States and was considering up to 100 rural Nebraska post offices for potential closure. These plans would not have eliminated postal service in rural Nebraska but would have reduced the quality of service. There was widespread disapproval of plans to close rural post offices despite the costs of maintaining these facilities. For example, in the September 15, 2011 *Fort Report*, Nebraska Representative Jeff Fortenberry wrote "My Nebraska House of Representatives colleagues and I have urged the Postmaster General to consider the USPS's obligation to maintain efficient mail delivery to all Americans and the special challenges posed by the closing of post offices in rural communities." In an October 7, 2011 release entitled *Rural Post Offices Are Critical to the Third District*, Congressman Adrian Smith wrote "In April of this year, I, along with my colleagues from Nebraska, sent a letter to the Postmaster General of the USPS urging the agency to account for the impact on local communities when considering the closing or consolidation of a rural mail facility." In a press release on May 3, 2012, Senator Ben Nelson provided the following quotation "Our local post offices play a special role in our communities, keeping us connected to our friends and families, and keeping businesses connected to their customers. They are an important part of our economy, serving every city, suburb and small town in Nebraska." Each of these statements expressed a commitment to providing service to rural areas despite potential savings and each statement anticipated significant impacts on rural communities in the event that service was reduced. Each was an eloquent defense of the principal of universal service, as much as the commitment to the state and local transportation network, and akin to spending to provide broad-based access to health care services in Nebraska.

In the case of health care services, the State of Nebraska also has a series of initiatives to improve access to health care services throughout the State. Both the federal and State governments support the rural system of Critical Access Hospitals by providing cost-based reimbursements (or cost-based reimbursements plus 1% for Medicare) to these smaller, rural hospitals. Reimbursements through both the Medicare and Medicaid programs (Radford, Hamon and Nelligan, 2010),[12] may reflect the higher cost structure found in smaller, rural hospitals. Additional tax dollars devoted to the cost-based reimbursement of rural hospital provide the benefit of more universal access to hospital services for rural residents. A similar approach is used to help locate additional health care professionals in rural areas of the State.

[12] Radford, Andrea, Mike Hamon and Caitlin Nelligan, 2010. "State's Use of Cost-Based Reimbursement for Medicaid Services at Critical Access Hospitals," *Findings Brief, North Carolina Rural Health Care Research & Policy Analysis Center* (April)

The Nebraska Student Loan Program and Nebraska Loan Repayment Program help pay the higher education costs of health care professionals who work for between one and three years in State designated shortage areas, which typically include Nebraska's non-metropolitan counties.[13] Thus, the State of Nebraska utilizes State revenue to ensure more universal health care services to rural Nebraska, in a way to cover the higher per user costs found in rural Nebraska.

B. Importance of Telecommunications Services for Health and Education

Telecommunications services also play a critical role in allowing the delivery of key health care and education services to rural Nebraska. Delivery of these services typically received substantial financial support at the State level in Nebraska; for example, through State aid to education or through Medicaid funding. In this context, support for telecommunications infrastructure through the NUSF can be seen as part of the State funding mechanism for effective delivery of these services. Such education and health care services can substantially enhance the quality of life among rural residents, a key factor in maintaining population levels.

Telecommunications infrastructure is critical in the delivery of telemedicine services to patients both at home and at rural health care clinics. The American Telemedicine Association defines three primary categories of telemedicine services (www.americantelemed.org):

- Specialist referral services
- Patient consultations
- Remote patient monitoring

The first category, specialist referral services, would occur in a clinic setting. Doctors and other primary care providers would utilize the Internet over broadband infrastructure for real-time communications between the specialist, patient, and primary care provider. Broadband infrastructure also could be used to transfer data and images to specialists for physician-to-physician consultations. This feature of telemedicine services substantially reduces patient costs for access to the services of specialists located in urban areas; and by lowering specialty medical costs will increase the likelihood that rural patients will choose to access these services, particularly in a preventative setting.

The other two categories as defined by the American Telemedicine Association improve rural patient access to general medical and diagnostic services, and in settings even closer to home. Patient consultations are defined to include patient consultations with primary or other

[13] http://dhhs.ne.gov/publichealth/Pages/hew_orh_loansstate.aspx

physicians. From a rural clinic, patients communicate in real time via the Internet or a dedicated line with physicians at a different location. This approach substantially lowers the cost for primary care physicians serving a larger geography by reducing or eliminating the need for physicians to visit these rural clinics. Likewise, telemedicine patient consultations could expand the territory served by a physician or even increase the competition between alternative physician groups and health care networks for the business of patients who reside in small communities and the rural countryside.

Remote patient monitoring refers to a set of telemedicine services delivered into the homes of patients. Equipment could be placed in patient homes to monitor vital signs, blood pressure, blood sugar or make other measurements and transmit this information continuously using broadband infrastructure to be monitored by health care professionals. Network reliability is obviously especially critical in the case of remote patient monitoring, pointing to the importance of broadband to the home in providing this service. However, all types of telemedicine services would benefit from the enhanced reliability of broadband service.

Broadband infrastructure also can be central to delivering educational content to students and other residents in rural communities. For example, distance learning course opportunities supported by broadband infrastructure allow students in rural settings to participate in advanced placement or language courses that are not offered at their local school. Such improved access has potential to address a critical issue as participation rates in advanced placement courses are often much lower among rural students. Alger (2011)[14] notes research that rural students nationwide are one-third as likely to enroll in an advanced placement course as suburban or urban students. Broadband infrastructure is also essential to support streaming videos and lectures that are a critical in taking on-line college courses (Kuttner, 2012).[15] Post-secondary courses, in particular, are likely to be delivered in the home, necessitating home access to broadband infrastructure. However, on-line courses can be a component of education delivery for home-schooled students and could also be an option for a portion of the courses for students who attend public school. Broadband technology also can be critical in providing rural students access to supplementary curriculum and study materials available from Nebraska's Virtual School program (Alger, 2011).

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[14] Alger, Vicki, 2011. Virtual Schools: The Vital Need for Virtual Schools in Nebraska. Platte Institute for Economic Research.

[15] Kuttner, Hans, 2012. *Broadband for Rural America: Economic Impacts and Opportunities*, Hudson Institute Economic Policy/Briefing Paper Prepared for the Economic Summit on the Future of Rural Communications, October.

VI: Summary

This Report by the University of Nebraska-Lincoln Bureau of Business Research provides a broad-based analysis of the role of universal service and the NUSF to the competitiveness of rural businesses and communities, especially in light of the critical role of rural businesses in the Nebraska economy. A key finding is that rural agricultural and non-agricultural businesses play a critical role in supporting employment and business activity in both trade center communities and in the metropolitan areas of Omaha and Lincoln. Rural businesses support thousands of jobs in the two metropolitan areas. What is more, access to the types of cutting edge services afforded by broadband infrastructure is an important factor influencing the growth of rural business. We find that investment in more advanced broadband services is correlated with business income, business location, education levels and the presence of young adults in rural Nebraska communities. Further, State and federal Universal Service Funds play a key role in the development of broadband infrastructure within small towns and the surrounding rural areas of Nebraska. Estimates indicate that the level of investment would decline by nearly 50% without support from these Universal Service Funds. These benefits may be the reason that the State of Nebraska has maintained a commitment to ensure universal access to advanced telecommunications and information services to rural Nebraska.

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Appendix 1

About the UNL Bureau of Business Research and Key Personnel

A. The Bureau of Business Research

The Bureau of Business Research is a leading source for analysis and information on the Nebraska and Great Plains economy. The Bureau conducts both contract and sponsored research on the economy of states and communities including: 1) economic and fiscal impact analysis; 2) models of the structure and comparative advantage of the current economy; 3) economic, fiscal, and demographic outlooks, and 4) assessments of how economic policy affects industry, labor markets, infrastructure, and the standard of living. The Bureau also competes for research funding from federal government agencies and private foundations from around the nation and contributes to the academic mission of the University of Nebraska-Lincoln through scholarly publication and the education of students. The Bureau website address is www.bbr.unl.edu.

B. Key Personnel

Dr. Eric Thompson – Principal Investigator

Dr. Eric Thompson will be the principal investigator on this project. Dr. Thompson is the Director of the Bureau of Business Research and an Associate Professor of Economics in the College of Business Administration at the University of Nebraska-Lincoln. Dr. Thompson has conducted a broad group of economic impact studies including economic impact studies of the Sandhill Cranes migration, the Nebraska child care industry, the Omaha Zoo, the Nebraska winery and grape growing industry, Husker Harvest Days, and the UNL Athletic Department. Dr. Thompson also works on demographic projections and analyses of economic development programs for Nebraska and cities in Nebraska. He also has conducted numerous economic studies for the Lincoln Department of Economic Development, the Omaha Chamber of Commerce, the Nebraska Department of Economic Development, various Nebraska industries, and Nebraska tourism attractions. Dr. Thompson's research has received support from the United States Department of Labor, the United States Small Business Administration, the Robert Wood Johnson Foundation, the Center for Economic Analysis, the Nebraska Health and Human Services System, as well as Lincoln, Omaha, and Nebraska organizations and

agencies. In his previous employment, Dr. Thompson served as the Director of the Center for Business and Economic Research and a Research Associate Professor of Economics at the University of Kentucky. Dr. Thompson received his Ph.D. in agricultural economics from the University of Wisconsin-Madison in 1992. His research fields include urban and regional economics, economic forecasting, and state and local economic development. His research has been published in *Regional Science and Urban Economics*, the *Journal of Regional Science*, the *American Journal of Agricultural Economics*, the *Journal of Cultural Economics*, and the *Economic Review of the Federal Reserve Bank of Cleveland*.

Director Jeff Pursley – Co-Investigator

Jeff Pursley is an economic consultant based in Lincoln with substantial experience working in the telecommunications industry in both the private and public sector. Mr. Pursley's research has included the modeling of generation of electricity through the use of wind resources by the private sector in Nebraska as well as measuring the energy efficiency savings associated with the Nebraska Energy Office's Home Weatherization and Energy Loan programs. He has also developed statistical analyses comparing the results of the Federal Communications Commission's CQBAT model, used for federal universal service funding purpose, for insular and non-insular price cap carriers. His work in the public sector includes serving on the staff of the NPSC. Mr. Pursley is in the process of finishing his master's thesis for a Master of Arts degree in economics.